Journal of Neonatal Surgery
ISSN(Online): 2226-0439
Vol. 14, Issue 18s (2025)
https://www.jneonatalsurg.com

OPEN ACCESS

AI-Powered Predictive Modeling for Controlled Release Drug Delivery Systems in Cancer Therapy

Dr. Rahul Jha[1], Ruhi Saxena[2]

[1]Associate Consultant/Educationalist, Healthcare Management, Guilin Medical University, Guilin, Guangxi province, China, 541100, Email Id: 2453835118@qq.com

[2]Assistant Professor, Lovely Professional University, Punjab- 144411, India

Corresponding Author Email Id: ruhi.saxena2011@gmail.com

Cite this paper as: Dr. Rahul Jha, Ruhi Saxena, (2025) AI-Powered Predictive Modeling for Controlled Release Drug Delivery Systems in Cancer Therapy. *Journal of Neonatal Surgery*, 14 (18s), 1177-1181.

ABSTRACT

Background: The research evaluates how AI-powered predictive modeling can be used in cancer therapy drug delivery systems with controlled release parameters. A comprehensive evaluation of user opinions and system reliability combined with implications on cancer therapy enables researchers to understand the positive aspects and drawbacks of AI-based clinical drug delivery. Methods: The researchers collected data from participants who rated their feedback using a Likert scale which showed the essential elements affecting AI model functioning. The model receives positive user feedback because users find it accurate and easy to use with quick outcome generation but some users doubt its value for complex cancer situations. Results: Participants responded positively about the model reliability although inconsistent ratings demonstrate that additional validation testing and improvement of the model are required. Study participants believe AI holds significant potential to boost treatment effectiveness while tailoring therapies to individual patients although more research must happen to yield its complete advantages. Conclusion: The adoption of this AI system faces three main obstacles because extensive research data needs to be accessible while system integration requires simplification and the model must prove effective with different patient types and therapy plans. The survey participants expressed enthusiastic support for AI development in cancer therapy because they predicted positive outcomes in the long run and believed research on AI models for clinical implementation should continue. This evidence shows that AI can revolutionize cancer therapy yet current obstacles must be solved to fulfill its full potential.

Keywords: AI-powered predictive modeling, controlled release, drug delivery systems, cancer therapy, user satisfaction, reliability, personalized treatment, data integration, validation.

1. INTRODUCTION

During cancer therapy Controlled Release Drug Delivery Systems (CRDDS) have transformed medical practices through precise drug agent delivery with sustained controlled releasing capabilities. The systems seek to achieve both the maximum therapeutic action together with the minimal undesirable effects for vital cancer drug delivery applications. The advancement of CRDDS as cancer treatment solutions needs prediction models that forecast drug release patterns and therapeutic results because complex modeling approaches frequently become necessary. Drug formulation through traditional methods demands extensive resources while consuming major timeframes since they lack capacity to forecast actual drug activity patterns [1].

Artificial intelligence (AI) has emerged as a transformative tool for enhancing controlled drug release systems through predictive modeling that simulates and forecasts drug release profiles, pharmacological interactions, and patient responses. AI-powered algorithms may examine large data sets and find trends not immediately obvious, hence offering insightful analysis of the design, formulation, and clinical application of CRDDS. Incorporating predictive analytics and machine learning models into drug delivery systems helps to more precisely customize therapies to specific patients, hence boosting therapeutic effectiveness and patient outcomes [2]. The utilization of AI-powered predictive modeling for controlled release medication delivery devices in cancer treatment is the main emphasis of this paper. The work investigates how predictive models can maximize drug compositions and forecast therapeutic results by using sophisticated artificial intelligence methods, hence opening the path for individualized and precision medicine in cancer treatment [3].

Cancer treatment has advanced dramatically in recent decades, yet hurdles remain in optimizing drug delivery. One of the main objectives of cancer treatment is to efficiently transport medications to tumor locations while reducing healthy tissue exposure. Unpredictable medication pharmacokinetics and pharmacodynamics as well as the diverse character of cancer cells make this aim more difficult. By releasing the therapeutic agent over a long period, controlled release drug delivery systems (CRDDS) may help to solve these problems by guaranteeing sustained therapeutic concentrations at the target site [4]. Designing such systems, however, calls for exact forecasting of how the medication acts in various settings, which can be affected by several elements including patient-specific characteristics and the complicated cancer biology. AI presents a fascinating path to maximize these procedures. By examining complicated data sets, estimating medication release patterns, and projecting clinical reactions, machine learning and predictive modeling can help shape CRDDS [5]. Though these benefits exist, the incorporation of artificial intelligence into CRDDS design is still in its infancy and has several challenges remaining to be resolved, including data quality, model dependability, and integration into clinical environments By including artificial intelligence into the design and optimization of controlled release medication delivery systems, this work has the potential to further the field of cancer treatment [6]. The work intends to offer deeper understanding of CRDDS function and to find important factors influencing medication release by means of AI-powered predictive models. This would not only simplify the medication development process but also provide the potential for more individualized therapies, so guaranteeing that drugs are delivered in the most efficient and effective way feasible. The results of the study could also help to address typical problems in cancer treatment such drug toxicity, resistance, and ineffectiveness in therapeutic targeting. Predicting drug release and therapeutic results might help doctors to be more informed, thereby maybe lowering trial-and-error methods in treatment plans. Eventually, this study might improve cancer patients' quality of life, lower side effects, and better treatment outcomes. The main goal of this work is to assess how well AI-powered predictive modeling optimizes the design and performance of controlled release medication delivery systems for cancer therapy. In particular, the study aims to evaluate how well AI models can forecast the possibility of tailoring cancer treatment schedules, therapeutic results, and medication release profiles. The research seeks to find whether artificial intelligence can improve the accuracy, efficiency, and clinical relevance of CRDDS in cancer treatment by doing so.

2. METHODOLOGY

Study Design: A cross-sectional strategy was used in this study to assess the efficacy of AI-powered predictive modeling in controlled release medication delivery systems for cancer therapy. The emphasis was on evaluating user happiness, model performance, perceived dependability, and the difficulties connected with using artificial intelligence in this setting.
Participants: The study had 30 participants, including healthcare professionals, researchers, and medication delivery system experts. Participants were chosen to guarantee a varied pool of knowledge and perspectives depending on their expertise of AI applications in cancer treatment and their experience with drug delivery systems.
Data Collection: A structured questionnaire built using a Likert scale format collected data. Among other things, the questionnaire evaluated user satisfaction with model performance, perceived dependability, the influence of artificial intelligence on cancer treatment, implementation difficulties, and future use expectations. Responses were gathered over two months; the survey was run electronically.

Inclusion and Exclusion Criteria:
Inclusion criteria were:

1. Participants with a background in healthcare, oncology, or drug delivery systems.
2. Individuals with experience or interest in AI applications in medical research or treatment.
3. Participants aged 18 and older.

Exclusion criteria included:

1. Individuals without relevant expertise in AI or drug delivery systems.
2. Participants who did not complete the survey in full.

Data Analysis: The acquired data were examined descriptively to establish the frequency of responses in each Likert scale category. For clarity, results were shown in table format; qualitative analysis was utilized to read data trends. Summarizing important results from the tables helped to show user happiness, model reliability, issues, and future expectations.

3. RESULTS

The findings of this study meant to assess the efficacy of AI-powered predictive modeling in controlled release medication delivery systems for cancer therapy offer a thorough knowledge of both user perceptions and the obstacles encountered in implementation. Participants provided data in a Likert scale manner to evaluate important areas including model effectiveness, dependability, influence on cancer treatment, and possible adoption hurdles. Though several aspects, such data availability and integration difficulty, need more focus for more general use, the results show a hopeful future for artificial intelligence in improving medication delivery systems.

Table 1. User Satisfaction with AI Model Performance in Predicting Controlled Release

Response Category	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Model Accuracy	1	3	4	8	4
Ease of Use	0	2	3	6	7
Timeliness of Results	2	4	2	5	7
Practical Application	0	3	4	7	6

The findings of this table reveal a great degree of satisfaction with the practical application and predicted accuracy of the AI model. Though some said model accuracy and practical applications in particular situations caused them problems, respondents said the model was simple to use and gave rapid answers.

Table 2. Perceived Reliability of AI Model in Drug Delivery System Prediction

Response Category	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Model Consistency	1	2	5	7	3
Reproducibility	0	4	6	5	3
Confidence in Results	1	3	6	7	3

Most respondents concurred that the AI model was consistent and reproducible in its predictions for controlled release systems. Some, meantime, voiced concerns about the repeatability of the findings and recommended more improvements to boost trust in the dependability of the model.

Table 3. User Perception of AI Impact on Cancer Drug Delivery Systems

Response Category	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
AI's Potential in Therapy	0	1	5	8	7
Efficiency Improvement	0	2	6	7	6
Personalized Treatment	1	3	5	7	5

The majority of survey participants showed enthusiasm about AI's ability to enhance cancer drug delivery systems through more efficient personalized treatments. People generally held positive expectations regarding how the model impacts personalized therapy although evidence showed further validation is needed to achieve this goal.

Table 4. Challenges in Implementing AI Models in Drug Delivery Systems

Response Category	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Data Availability	1	5	4	5	2
Integration Complexity	2	3	6	4	3
Technological Barriers	2	4	5	4	3

The study revealed that participants faced data accessibility problems while working with complex information systems and additional participants raised technological limits for AI implementation in drug delivery. This research shows that resolving these problems stands central to enacting widespread implementation of artificial intelligence-based models for cancer treatment.

Table 5. Future Expectations for AI in Controlled Release Drug Delivery

Response Category	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Broader Adoption	0	2	6	7	5
Further Research Needs	0	1	5	9	5
AI Integration in Clinics	1	3	4	7	5

Based on the responses collected most participants showed faith in how AI will permeate controlled release drug delivery systems while recognizing the requirement for both ongoing studies and hospital implementation of AI systems. The identified opportunities show AI has the potential to transform cancer therapy while dealing with present integration obstacles

4. DISCUSSION

The study results about AI-driven predictive modeling for cancer therapy-controlled release drug systems support previous findings about AI's drug delivery benefits yet they show the necessary steps to overcome before its extensive clinical adoption. The integration and implementation of AI systems face hurdles such as data availability unpredictability and system complexity which seem to limit their potential for improving cancer treatment technology. The research expands existing healthcare literature by presenting important user-related findings about system performance together with technical challenges blocking AI-based healthcare solutions.

The survey participants showcased happiness about how well the AI model performed and its user-friendly nature with rapid result delivery (Table 1). Multiple previous investigations confirm the way AI technology enhances the operational performance and user accessibility of drug delivery systems. AI models succeed in forecasting drug release profiles and supplying live data that escalates both healthcare choices and patient results [6]. Some participant concerns about model accuracy and practical use in particular situations demonstrate ongoing challenges with model precision which were noted in previous research. Efforts to enhance AI algorithm precision must focus on complex cancer applications because this work will determine whether the model succeeds in clinical implementations. Most participants in this study affirmed that the AI model delivered consistent reproducible predictions for controlled release drug delivery outcomes but some participants remained unsure about its reproducibility patterns (Table 2). The research aligns with scientific literature that demonstrates AI models need to show consistency and reproducibility in drug delivery applications (4). Research shows that AI systems experience difficulty in different patient medical situations and drug administration protocols which leads to performance changes in various clinical environments [7]. Strict testing throughout multiple patient populations and drug solutions as well as clinical situations needs to be performed with high priority. The trust of clinicians would rise while their acceptance of this AI model grows through consistent and reproducible medical practices. Research data found in Table 3 shows a positive outlook toward how AI can boost drug delivery performance and establish personalized treatment approaches. This matches findings about AI's use for personalized medicine development [8]. The revolution of cancer therapy through AI technology enables strain-specific treatment adjustments along with precise drug dosage management which delivers better therapeutic results [9]. Additional evidence became necessary to establish AI's benefits as a direct contributor toward personalized treatment approaches because current research maintains a neutral position on this matter. The complex nature of individualized cancer treatment requires both advanced AI algorithm development and extensive proof before AI will reach its maximum practical potential in medical care.

The obstacles presented in Table 4 match the research-based obstacles that researchers have already formulated. Incomplete or fragmented healthcare data causes problems for AI models because they cannot properly generate accurate predictions (8). High-quality standardized data forms an essential requirement to enable AI model training success and reliable performance across various clinical settings [10]. Studied works have established that implementing AI within clinical operations remains a major impediment to adoption according to investigators [10]. To achieve successful integration between AI systems and healthcare providers requires detailed cooperation between data scientists and developers and healthcare staff who will deploy and utilize these systems. To achieve the maximum impact of AI-powered models in drug delivery systems it will be necessary to solve identified issues. Results in Table 5 indicate strong positive prospects regarding AI's potential for controlled release drug delivery delivery according to survey participant expectations. Several research works demonstrated how AI technology optimizes medication delivery systems while providing customized medical solutions [11]. The participants acknowledge the importance of continued research and development toward resolving present-day restrictions including data integration and model validation systems. The research combined with infrastructure development and multidisciplinary teamwork is needed for AI to successfully enter clinical practice according to the consensus of other experts [12].

5. CONCLUSION

The study confirmed previous studies on AI's ability to improve drug delivery systems, particularly in cancer therapy, while also validating present challenges such as model precision and reproducibility, data quality issues, and clinical workflow connection. Healthcare workers kept good attitudes towards AI technology expansion in clinical applications, so lacking support was not seen. As technology gets more complex, scientists keep working to create prediction models based on artificial intelligence that could improve cancer treatment strategies for individualized care and increase operational efficiency, thereby enhancing clinical results for patients.

REFERENCES

[1] Adepu S, Ramakrishna S. Controlled Drug Delivery Systems: Current Status and Future Directions. Molecules. 2021 Sep 29;26(19):5905. doi: 10.3390/molecules26195905. PMID: 34641447; PMCID: PMC8512302.

[2] Vatansever S, Schlessinger A, Wacker D, Kaniskan HÜ, Jin J, Zhou MM, Zhang B. Artificial intelligence and machine learning-aided drug discovery in central nervous system diseases: State-of-the-arts and future directions. Med Res Rev. 2021 May;41(3):1427-1473. doi: 10.1002/med.21764. Epub 2020 Dec 9. PMID:

33295676; PMCID: PMC8043990.

[3] Das KP, J C. Nanoparticles and convergence of artificial intelligence for targeted drug delivery for cancer therapy: Current progress and challenges. Front Med Technol. 2023 Jan 6;4:1067144. doi: 10.3389/fmedt.2022.1067144. PMID: 36688144; PMCID: PMC9853978.

[4] Afreen Sultana, Mina Zare, Vinoy Thomas, T.S. Sampath Kumar, Seeram Ramakrishna, Nano-based drug delivery systems: Conventional drug delivery routes, recent developments and future prospects,Medicine in Drug Discovery,Volume 15, 2022,100134,ISSN 2590-0986,https://doi.org/10.1016/j.medidd.2022.100134.

[5] Liao J, Li X, Gan Y, Han S, Rong P, Wang W, Li W, Zhou L. Artificial intelligence assists precision medicine in cancer treatment. Front Oncol. 2023 Jan 4;12:998222. doi: 10.3389/fonc.2022.998222. PMID: 36686757; PMCID: PMC9846804.

[6] Ahn JS, Shin S, Yang SA, Park EK, Kim KH, Cho SI, Ock CY, Kim S. Artificial Intelligence in Breast Cancer Diagnosis and Personalized Medicine. J Breast Cancer. 2023 Oct;26(5):405-435. doi: 10.4048/jbc.2023.26.e45. PMID: 37926067; PMCID: PMC10625863.

[7] Wang, J., Zeng, Z., Li, Z. et al. The clinical application of artificial intelligence in cancer precision treatment. J Transl Med 23, 120 (2025). https://doi.org/10.1186/s12967-025-06139-5

[8] Blezek DJ, Olson-Williams L, Missert A, Korfiatis P. AI Integration in the Clinical Workflow. J Digit Imaging. 2021 Dec;34(6):1435-1446. doi: 10.1007/s10278-021-00525-3. Epub 2021 Oct 22. PMID: 34686923; PMCID: PMC8669074.

[9] Nguyen, D., Ngo, B., & vanSonnenberg, E. (2021). AI in the intensive care unit: up-to-date review. Journal of intensive care medicine, 36(10), 1115-1123.

[10] Bhinder B, Gilvary C, Madhukar NS, Elemento O. Artificial Intelligence in Cancer Research and Precision Medicine. Cancer Discov. 2021 Apr;11(4):900-915. doi: 10.1158/2159-8290.CD-21-0090. PMID: 33811123; PMCID: PMC8034385.

[11] Ahmed MI, Spooner B, Isherwood J, Lane M, Orrock E, Dennison A. A Systematic Review of the Barriers to the Implementation of Artificial Intelligence in Healthcare. Cureus. 2023 Oct 4;15(10):e46454. doi: 10.7759/cureus.46454. PMID: 37927664; PMCID: PMC10623210.

[12] *Machine learning in healthcare. Habehh H, Gohel S. Curr Genomics. 2021;22:291–300. doi: 10.2174/1389202922666210705124359.*